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The Future of the Foundry Industry

It is apparent that there will be some control of industry for a prolonged period after the termination of hostilities. This is necessary in order to avoid the chaos which would result from the closing down of munitions works, before catering for the home and export market had properly got into their stride. There is a section of the populace which is strongly opposed to any thought being given at the moment to post-war problems. This attitude of mind recalls that in 1939 the policy committee of a popular daily picture paper consistently prevented the editorial department from featuring German war preparation news, as it was bad for business! The peace will last longer than the war and its battles will mean just as much to the welfare of the average citizen as military engagements. Just as it was of paramount importance that we should have been prepared for war, so, too, it is necessary that plans should be laid for the successful return to peacetime conditions. For much of the foundry industry—a matter usually forgotten by writers on this subject—its future depends upon the prosperity of the trades for which individual units cater. Foundries making ingot moulds or castings for the printing machines depend entirely upon the activity of their customers. It has been our experience that the foundry industry is never uniformly busy. We have known the steelfoundry section working at 15 to 20 per cent. capacity, whilst the light-castings trade was really busy—the exact reverse of present-day conditions. The war has disturbed the industry as a whole, for there has been a great expansion in steel and light alloys. The former is doing, so far as we are aware, but we hope our surmise is wrong, nothing in the direction of post-war development, yet it is the one section of the industry which experiences the greatest difficulties the moment armament orders slacken off. The light-alloy castings industry is not only fully alive to its post-war problems but is making preparations to overcome them. The section of the iron-founding industry which has its destiny more in its own hands than most is that catering for the building trades. It is obvious that for a prolonged period orders will be plentiful, but much work will have to be done to recapture the not-inconsiderable export trade it did in baths, cisterns, stove grates and cookers. Architects are becoming, through war conditions, very familiar with non-metallic substitutes for cast iron and brass. Moreover, some are being attracted to the idea of communal hot water supply, which would adversely affect quite a few foundries, whilst probably benefiting others. Selling finished or virtually finished articles, as against components to be built into machinery or perform some engineering function, necessitates a difficult type of technical organisation. Despite the stories of the lack of co-operation, in general engineers and foundrymen do appreciate each other's difficulties, but the firms making materials to be sold to the general public through merchants and public-utility concerns have to cater for the vagaries of fashion, create selling points, and meet the competition of other industries. The shop windows of the gas and electricity companies must be as artistic and as well-dressed as the furniture shop next door. Thus on the designer much depends for the future of this type of foundry work.

The very large export business done in cast-iron pipe in pre-war days will only be revived if tariff walls are kept at a reasonable level, and there is no rush, as there has been during the last decade, to get foreign currency at any price! There is but little fear of encroachment being made on the home market, though there is bound to be some from steel pipes. For general engineering castings,

(*Continued overleaf.*)

Contents

The Future of the Foundry Industry, 153.—Diffusion of Metals in Steel, 154.—U.S. Steel Output, 154.—Indian Steel Industry, 154.—Sand Casting of Silicon Bronzes and P.M.G. Metal, 155.—Book Reviews, 160.—Patternmaking Wrinkles—I, 160.—Cupola-Melted High-Duty Cast Irons, 161.—Delay in Magnetic Response, 165.—Institute of British Foundrymen, 166.—Moulding and Casting a 6½-ton Crusher Shell, 167.—Casting Pit Refractories, 169.—Magnesium from Dolomite, 170.—News in Brief, 172.—John Fowler & Company (Leeds), 172.—Personal, 172.—Company News, 174.—Obituary, 174.—New Companies, 174.—Stone Platt Engineering Company, 174.—Raw Material Markets, 176.

THE FUTURE OF THE FOUNDRY INDUSTRY

(*Continued from previous page.*)

the competition from weldings is likely to be less severe, as now that novelty has worn off, their popularity is on the wane. On the other hand the high-duty irons are finding increased favour with the designers and their future is indeed bright. The most alarming aspect is the potential competition from plastics. Before the war, they had won some ground from the ironfounders for the supply of fuse box covers to the electric supply concerns, but the publicity campaign they are now carrying out by advertisements in the daily Press, threatens the entry into lighter engineering industries. For instance, they promise that most of the components of the sewing machine will be made in plastics. The present-day portable domestic machine is unquestionably on the heavy side and many women ask for male help to transport it. Yet we are given to understand, a "fair" weight is necessary in order to ensure rigidity, and what this weight is should be ascertained because sewing machines sometimes undertake quite heavy-duty work. Clamping is not satisfactory as it injures the table top. Moreover, it has been found that in the modern kitchen where the table top is vitreous enamelled, there is nowhere to clamp even the mincing machine, and the design needs changing in detail. The typewriter frame is another item to be attacked by the plastics industry. Yet, despite these and similar cases, the future of the industry, if it will but adapt itself to modern ideas, is quite bright, especially if it makes the fullest use of vitreous enamel. The colours given by this medium are much more pleasing than those given by plastics, which lack lustre.

INDIAN STEEL INDUSTRY

India's steel industry is now producing at its maximum capacity. The output of finished steel is 50 per cent. more than in peacetime. Production is expected to be doubled when extensions to plant, at present in hand, are completed. The establishment of a Governmental and industrial organisation to secure the effective co-ordination of India's production of war supplies, has been suggested by the American technical mission now in India, in a preliminary report to the Viceroy. The mission considers that war production has made a fairly good start in India, but must be developed much further if India is to become the arsenal of the Middle East. The preliminary report deals mainly with the possibility of extending output by improving upon present machinery, including the removal of bottlenecks, and steps to minimise the congestion of harbours and to increase transport facilities.

DIFFUSION OF METALS IN STEEL

A series of preliminary experiments carried out by H. CORNELIUS and F. BOLLENRATH on the diffusion of Mo, Cr, W, V, Ti, P, Si, Ni, Co and B in steels containing 0.05 to 1.3 per cent. C at temperatures up to 1,150 deg., described in the "Archiv für das Eisenhüttenwesen," indicates that the diffusivity of the elements, narrowing the γ-field of the iron and promoting carbide formation in steel, is considerably influenced by the carbon content. On the surface of the steel, a skin of carbide is formed by interaction of the diffusing medium and the carbon in the steel, which reduces the diffusion the more the greater the stability of the carbide; thus steels with a high carbon content take up practically no Ti. The carbide skin is not the only factor inhibiting in-diffusion, for elements restricting the γ-field but forming no carbides in the steel also suffer a progressive reduction in diffusivity with increase in the carbon content, although the effect is by no means as pronounced as with active carbide-forming elements. The reduction in the width of the δ-range with rising carbon content may be attributed, in the case of elements restricting the γ-field, to the action of the carbon which raises the stability of the austenite and hence makes the formation of a δ-range more difficult. The effect of carbon is fairly small on the diffusion of those elements which extend the γ-field of the iron or which promote the formation of carbides in steel only slightly or not at all. The diffusivity of B, as an example of the elements reducing the γ-field of the iron, is marked in low-C and high-C steels. Carbon does not appreciably hinder the in-diffusion of B in iron, although in steel this element strongly promotes carbide-formation.

U.S. STEEL OUTPUT

In March, 7,392,911 net tons of steel ingots and castings were produced in the United States, according to the American Iron and Steel Institute. The March total, which is an all-time record, exceeded by more than 150,000 tons the previous peak of 7,236,068 tons produced in October, 1941, and was more than 260,000 tons greater than the output of 7,124,003 tons in March, 1941. In February, 1942, with three fewer working days, 6,521,056 tons were produced. Total steel production in the first quarter of this year was 21,038,889 tons, or nearly 4 per cent. above the total of 20,276,709 tons produced in the first quarter of 1941. During the quarter, steel production averaged 96.3 per cent. of the industry's capacity; at the end of the quarter output was very near 99 per cent. of the rated capacity of the industry.

American Foundrymen's Association.—At the A.F.A. annual convention, Mr. H. S. Simpson said membership in the Association has risen to within just a few of 5,000, and that the 23rd chapter is now being formed among foundrymen of eastern Canada and Newfoundland. He urged all foundrymen and suppliers to join the organisation and to support all of its war efforts.

SAND CASTING OF SILICON BRONZES AND P.M.G. METAL

By W. MACHIN, O.B.E.

Part B.—The Manufacture and Properties of P.M.G. Metal: P.M.G. Hardener; Melting Procedure; Castings; Running Problems

(*Continued from page* 137.)

P.M.G. metal in its various grades is a silicon iron copper alloy, the standard mixture containing 88 per cent. copper, 10 per cent. hardener and 2 per cent. zinc. It was intended, during its development, to replace ordinary gunmetal and similar bronzes. The letters P.M.G. which were used to name the metal are intended to mean a metal which would replace "P" phosphor bronze, "M" manganese bronze or brass, and "G" gunmetal.

The tensile strength values in a cast and forged condition are superior. As a bearing metal its application requires careful consideration when comparing it with results that have been obtained from phosphor bronze. P.M.G. metal has given excellent results in some applications as a bearing metal and also where friction exists in wheels which are heavily loaded. At the present time, when

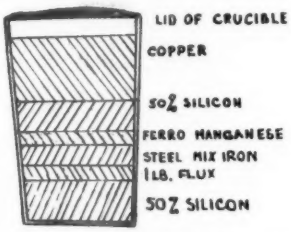


FIG. 1.—CRUCIBLE CHARGE FOR P.M.G. HARDENER.

tin is causing us to switch over to another alloy or alloys, this metal will no doubt be used more extensively. In view of this and the long experience the author has had in its manufacture, he has thought that it would be advisable at this stage to give a short practical account of the methods of manufacture of the metal, also some technical advice as to its use in the production of castings.

Tests Results Available

It would be too tedious to recount all the various tests which have been carried out, and therefore it is proposed to leave much of this matter for inquiries from members. The author has records of many tests carried out by various firms in Great Britain, America, Germany, France and other countries and this knowledge can, if desired, be published from time to time in the "Foundry Trade Journal," or can be sent to any member making the metal who may require any information. The tests cover the mechanical properties of the alloys with varying percentages of zinc and copper and from 1 to 10 per cent. hardener. There are also tests from metal up to as much as 20 per cent. hardener in the mix, and others made at various casting temperatures from 950 to 1,300 deg. C. Test results when mixing

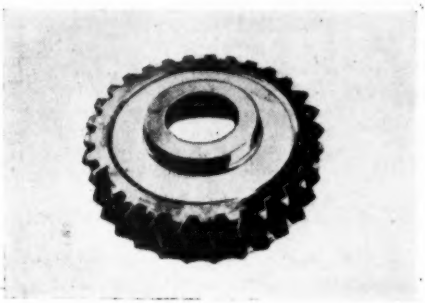


FIG. 2.—GEAR WHEEL BLANK IN ORDINARY P.M.G. METAL.

25 per cent. P.M.G. metal scrap, *i.e.*, heads and fins, and 75 per cent. P.M.G. metal borings taken from machined castings are also available.

There are also tests which have been carried out from green sand test-bars and dry sand test-bars, forged material at various temperatures, extruded bars, rolled sheet, compression tests, fatigue tests, torsion tests, shear tests, tests under various temperatures, corrosion, erosion, effective resistance to corrosive agents, and bearing tests. In addition there are figures for melting losses which have been carefully taken. The war effort to-day calls for the passing on of correct information amongst ourselves to enable production to be

P.M.G. Metal : Manufacture and Properties

handled satisfactorily in ali foundries. To withhold any information which will cause delay is playing into the enemies' hands.

Nature of P.M.G. Hardener

The hardener for P.M.G. metal is a substitute for tin, and the alloys are thus manufactured with the hardener incorporated to replace the tin in the various bronzes which may be made so that, for example, 88 per cent. copper, 10 per cent. hardener and 2 per cent. zinc would replace gunmetal. The test results have been obtained under proper supervision and will be found to be superior with P.M.G. metal than is or ever was the case with gunmetal. In view of this the Admiralty, War Office or any other authority should have no difficulty in deciding whether it can usefully replace the well-known alloy containing 10 per cent. of tin. A personal view is that much of the tin which has been used in the past should have been eliminated years ago. The hardener* can be made without difficulty in a good refractory plumbago crucible. The components are copper; silicon; phoshor copper (15 per cent. phosphorus); ferro-manganese (75 per cent. Mn approximately); and a steel-mix iron (preferably of the Emmel type).

FIG. 3.—P.M.G.-METAL WHEELS FOR CRANES, ETC.

Preparation of Hardener

The melting or manufacture of the hardener is carried out in the following way: A 300-lb. crucible is used to melt 100 lbs. of the hardener; this is done to get in the complete charge (with the exception of the phosphor copper) at the one operation. When charging the crucible the order is, half the silicon, then 1 lb. of Cuprex flux, iron, ferro-manganese, second half of the silicon, then copper. The lid is then placed on the crucible top, the fire of the melting pit made up to the top of the crucible with coke, and the lid of the pit fire then put in place. The pit fires used are natural draft and it takes two hours to melt 100 lbs. of hardener. After 1½ hr. in the fire the lid of the crucible is removed and the phosphor copper is added. After another ¼ hr., ½ lb. of Cuprex flux is added, the melt is stirred with clean iron rod, drawn, skimmed, and cast into ingots 9 in. long by 1½ in. thick. To make the question of the method of charging the hardener more clear, as this is considered a very important matter in the melting of same, Fig. 1 has been included.

FIG. 4.—A GEAR WHEEL AFTER 10 MONTHS' SERVICE.

The metal is allowed to cool in the ingot moulds, and afterwards taken into the metal store to be weighed and used exactly the same as tin. It is weighed out like tin to use in gunmetal, *i.e.*, 88 per cent. copper, 10 per cent. hardener and 2 per cent. zinc. After weighing it is charged exactly the same as gunmetal into a crucible and melted on the same lines, the zinc, of course, being added after the copper and hardener have been run down or melted. It will be found that the ingredients melt at about the same rate as gunmetal ingredients. In a good melting pit 300 lbs. of metal should be out of the fire in 45 mins. after charging the crucible.

Melting Procedure

No great care need be taken regarding the use of scrap, as 25 per cent. of P.M.G. metal scrap, 75 per cent. of P.M.G. metal borings from machined castings have given as much as 24 tons per sq. in. U.T.S. with 12 tons yield, and 21 per

* This hardener is a patented alloy, the property of Vickers-Armstrong, Limited, Barrow-in-Furness, with whom arrangements can be made to obtain permission to manufacture same.

P.M.G. Metal : Manufacture and Properties

cent. elongation. These figures are the best that have been obtained from scrap melts, and they give an indication of the quality when using up scrap metal. It is essential for all the scrap to be P.M.G. metal; it must not be contaminated with gunmetal or phosphor bronze scrap, as these two alloys contain tin, and tin is fatal to good results. The reason for this is that tin will not mix with P.M.G. metal either in low or high percentages. As to the temperature at which it is considered best to cast P.M.G. metal, the following figures may be of interest:—

FIG. 5.—STEAM FEED HEATER.

Casting Temperature.	U.T.S. Tons per sq. in.	Y.P. Tons per sq. in.	E. per cent. on 2 in.
Deg. C.			
1,300	23.2	11.2	16
1,140	23.2	10.8	19
1,100	24.4	11.2	20
1,050	25.2	12.4	21
1,000	18	12	4
950	16	12	3

It will be seen from the above figures that between 1,050 and 1,300 deg. C. will give the foundryman a very wide scope as regards thick and thin sections in a casting. He should from this information be able to pick out a temperature to cast his work successfully. The casting temperature figures detailed were carried out at a foundry in Belgium, and their correctness has been confirmed on many occasions in the foundry at Barrow.

Types of Castings Made

The very varied types of castings which have been made by brass moulders, used to the making of moulds for gunmetal work over a number of years, are well shown in Fig. 2, *et seq.* Fig. 2 shows a gear wheel blank made in ordinary P.M.G. metal with 10 per cent. hardener, which gave a continuous run of 50 hrs. of 97 r.p.m. run, with a forged steel worm, undergoing an estimated driving pressure of 3,760 lbs. on the teeth. Fig. 3 illustrates a further group of P.M.G. metal wheels for cranes and other applications, all of which have given excellent results in service.

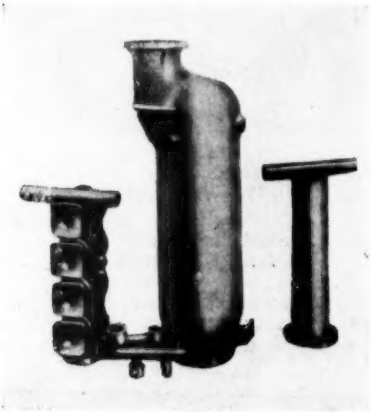


FIG. 6.—P.M.G. CASTINGS FOR INTERNAL-COMBUSTION ENGINES, ETC.

In Fig. 4, one of the wheels after service is shown; this was put into use on a very heavily loaded crane and was worked for 10 months, double the period given by competing bronzes for the same purpose. It was dismantled after the above period, and the photograph well indicates the degree of resistance to fatigue.

Fig. 5 shows a steam feed heater, the diameter of which is approximately 40 in. and the width is approximately 10 in. The water pressure applied to this casting was 600 lbs. per sq. in., and no leakage was traceable on this test. The perforated plate was cast solid, and the holes were drilled in it. This is obviously an intricate casting, and is a good example of testing the metal under liquid pressure.

P.M.G. Metal : Manufacture and Properties

Fig. 6 gives an indication of the variety of castings which have been produced in P.M.G. metal for internal combustion engines, marine engines, condenser work, etc. Macrostructures taken from sections of the castings are shown in Figs. 7 and 8. Many of these castings are

FIG. 7.—MACROSTRUCTURE OF ONE OF THE CASTINGS SHOWN IN FIG. 6.

guaranteed to resist water pressures up to 2,000 lbs. per sq. in. A further group of castings is shown in Fig. 9.

Such castings as condenser doors, 8 ft. 6 in. long and ⅜-in. wall section, feed regulator castings, and valve boxes for air compressors have been

FIG. 9.—CASTINGS IN P.M.G. METAL.

successfully made. In Fig. 10 chilled bush castings are shown.

Pressure-Resisting Results

It will be appreciated, after examining the variety of work illustrated, that the metal is one which can be used by the foundry to replace successfully gunmetal. In the author's opinion, 99 per cent. of the gunmetal castings which are being put into service to-day can be successfully made in this alloy.

As a further proof of this, fluid pressure tests have been carried out on a bush made in P.M.G. metal, and one made in gunmetal. The P.M.G. bush withstood a pressure of 6,000 lbs. per sq. in. without distortion, its size after machining being 10 in. long, 3-in. bore, and 3.75-in. outside diameter. The gunmetal cylinder of the same size, made from new metal run down and afterwards remelted,

FIG. 8.—MACROSTRUCTURE OF ONE OF THE CASTINGS SHOWN IN FIG. 6.

commenced distorting at 5,000 lbs. per sq. in. and fractured at 6,000 lbs., the length of the fracture being 0.2 in. The diameter of the bush in gunmetal after testing increased from 3.75 to 3.781 in., the bursting stress being 10.55 tons per sq. in.

The full details of these tests are available to members of the Institute, or perhaps a better way would be to publish them in THE FOUNDRY TRADE JOURNAL, when all could study the full particulars, which are very interesting.

Running Problems

The foundryman's job of deciding the best way to run and feed castings is not difficult, but a few

FIG. 10.—CHILLED BUSH CASTINGS.

notes on these technical matters may be of interest. In Fig. 11 is shown a tee piece, which would be run in one of the flanges, shown "A," with a feeder on the top of this flange, in which the runner is used. The position of the feeder is at "B." The metal cools somewhat during its passage through the mould, and it has been found in practice that it is only necessary to add a vent on each of the flanges shown at "C," the size of such

P.M.G. Metal: Manufacture and Properties

vents being sufficient at about ¼ in. dia.

Another casting section, shown in Fig. 12, is that for a stop valve. The runners in this case will be placed in one of the flanges, say at "A," with the feeder at "B." In each flange vents at "C" are used of the same type mentioned as for

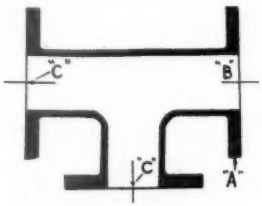


FIG. 11.—T-PIECE CASTING.

Fig. 11, that is, ¼ in. dia. For the casting shown in Fig. 13, which is a section of a four-way piece, the runner would be at "A," as in Figs. 11 and 12, the feeder placed at "B," and the vents, ¼ in. dia., placed from the top of each flange at "C."

These three technical cases give an indication to foundrymen concerning running and feeding. In the case of vents shown at "C," each case will be recognised by them as being used to release

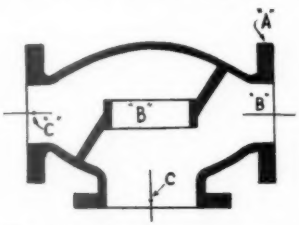


FIG. 12.—STOP-VALVE CASTING.

the air from the highest part of the casting. Castings of this character have been successfully manufactured up to 6 ft. in length. It is obviously not possible to give sizes of runners and risers in general, as all foundrymen know that this is only determined by the thickness of the casting and by the design. If, however, any advice is required on any particular casting the author will be pleased to help.

P.M.G. metal castings are very clean when removed from either green or dry sand moulds. The main reason for this is due to the fact that there is no tin in the alloy, as is the case in gunmetal. In view of this, there is no penetration into the sand as is sometimes the case with gunmetal. The metal sets very rapidly in green sand moulds, and castings can be stripped whilst red hot, and the metal will not scale in the atmosphere.

Regarding the question of sand used for manufacturing moulds and cores for P.M.G. metal to be cast in, it may be noted that any sand that is used

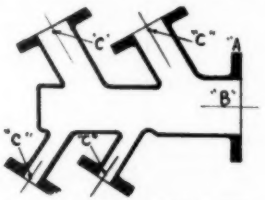


FIG. 13.—FOUR-WAY PIECE.

for the manufacture of moulds for gunmetal and other non-ferrous alloys is satisfactory when faced with lithite or plumbago, dusted on in the case of green sand, and sprayed on in the case of dry sand moulds. This method will give good results, and the castings should show a very clean skin when stripped.

(To be continued.)

Future of Centrifugal Castings.—C. E. Westover, vice-president of the American Foundrymen's Association, at a recent meeting, said the centrifugal casting of metals, which permits castings to replace forgings, will come into general use in the foundry trades and will make a great contribution to the war effort. Important discoveries have been made in this field, and many types of guns are now being made from cast metal instead of from forgings as hitherto. Under old methods of casting, 2 lbs. of metal frequently had been used to produce 1 lb. of finished material. Using the centrifugal method, cylinder castings are being produced on a pound for pound base with no loss in material. After the war castings will take the place of many forgings as the process is perfected.

The Nickel Bulletin.—The March issue of the Nickel Bulletin includes a description of a new American immersion type tungsten-graphite thermocouple for the rapid measurement of molten iron and steel. Other work of interest deals with bright plating, wetting agents in electrodeposition, the electrical resistance of high manganese-nickel-copper alloys, weldability tests for steels and the "Shotweld" process of welding stainless steel. Copies of the Nickel Bulletin may be obtained, free of charge, from the Mond Nickel Company, Limited, Grosvenor House, Park Lane, W.1. Individuals are requested to state the names of their firms or some other indication of their interest.

BOOK REVIEWS

Casting Alloys. Published by the British Aluminium Company, Limited, Oakley Manor, Belle Vue, Shrewsbury, Shropshire.

The value of this publication is indeed great, as it gives to the foundryman a more than usual complete picture of the properties of the aluminium alloys he habitually handles. Moreover, such useful information as the best casting temperature for each alloy is included. The general scheme followed is to give the standard composition, with the optimum permissable content of the normal impurities; the specific gravity; weight in lbs. per cub. in.; volume in cub. in. per lb.; solidification range, and all the usual mechanical properties in the "as-cast" and chill-cast conditions. These are presented statistically, but in addition there are paragraphs covering heat-treatment; properties and applications; resistance to corrosion and anodising qualities. No less than a dozen standard alloys are so covered. Finally, there are sections dealing with standard hardeners, and summaries of British Standard and D.T.D. specifications. Executives of the industry will doubtless be able to obtain a copy on application to the issuing house.

Engineering Mechanics. By B. B. Low, M.A. Published by Longmans, Green & Company, Limited, 43, Albert Drive, London, S.W.19. Price 12s. 6d. net.

Many young metallurgists are to-day required to possess a knowledge of mechanics for the carrying out of their duties, and this book provides a logical presentation of the subject in easily assimilible form. The book, which contains a large number of worked examples, takes the subject from simple velocity through acceleration, torque, work and energy when it reaches dimensions. From here onwards chapters are devoted to simple harmonic motion; analyses of cams; motion of rigid bodies in two dimensions; vibrations; and, finally, deflection of beams. Assuming the student has attained matriculation standard, the book can be thoroughly recommended as a well-graduated text-book for acquiring a theoretical knowledge of elementary mechanics.

Review of Iron and Steel Literature for 1941. By E. H. McClelland. Published by the Carnegie Library of Pittsburgh.

This is the twenty-fifth annual review made by the Library, and the complete collection must indeed make interesting reading. The compiler confirms the conclusion of Mr. Francis in his recent Paper to the London Branch of the Institute of British Foundrymen that the "best guide to the scattered literature is the periodical abstracts compiled by the Iron and Steel Institute." This 24-page pamphlet is extremely useful as a supplement to these abstracts for it gives a bird's-eye view of the non-periodical contributions to the literature of the subject as made, not only by the authors of books and university theses, but also by the trade publications.

Factory Ventilation in the Black-Out. Prepared by the Factory Department of the Ministry of Labour and National Service. Published by H.M. Stationery Office, York House, Kingsway, London, W.C.2, and elsewhere. Price 3d. net.

Some excellent examples are illustrated of easy methods of trapping light whilst ensuring adequate ventilation, in this twelve-page pamphlet. Especially would the reviewer call attention to Figs. 7 and 8 as being the most generally applicable to the roof of the average foundry building, if these are used, together with one or more of types illustrated in connection with side-lights and walls, then ventilation should be adequate. The time of this re-issue is particularly opportune, as the ill-effects of poor ventilation is most marked during the summer months.

PATTERNMAKING WRINKLES—I.

By "CHIP"

One of the most important tools of a patternmaker is the straight-edge or staff. While small straight-edges are usually made of metal, medium and larger ones are invariably made by the patternmaker of yellow pine. As much depends upon the accuracy of the straight-edge, great care must be exercised in its construction. Many craftsmen, when preparing new straight-edges or truing old ones, resort to the use of another for testing their work. This is not good practice, because the master straight-edge may be somewhat worn and consequently out of truth.

FIG.1.

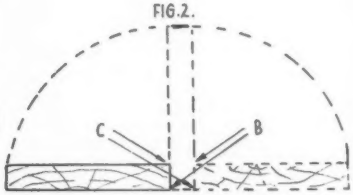


FIG.2.

FIG.3.

A far better way is to test in the following manner. Fig. 1 shows a section through a straight-edge, A being the face required to be tested. On a suitable board lay the straight-edge in the position shown in Fig. 1 and draw a line along edge B, then roll it over as dotted lines, Fig. 2, until edge B is uppermost. Edge C is then made to cover the line drawn by B and another drawn. If these coincide the straight-edge is true, but as it is invariably the case on the first trial the lines diverge as Fig. 3, then further planing is necessary to adjust until accuracy is obtained. Having obtained face A true, D can be gauged from A and, after planing to the marks, can be checked by a similar process.

CUPOLA-MELTED HIGH-DUTY CAST IRONS

FALKIRK SECTION DISCUSSION

Discussion mainly devoted to the Structure of these Irons, the Distribution of Graphite, and Problems of Nomenclature

After Mr. W. W. Braidwood had read his Paper* on "Experiences in the Production of Cupola-Melted High-Duty Cast Irons," before the Falkirk Section, MR. TYRIE, President of the Section, expressed the thanks of the members and congratulated the lecturer on his presentation of a most interesting Paper. The meeting was then declared open for discussion.

MR. W. W. BLAIR (Falkirk) asked Mr. Braidwood if inoculation would have any beneficial effect on high-phosphorus irons, such as were in use in the light-castings foundries of the area. He wondered if the lecturer had experienced any trouble due to high sulphur content in his irons.

MR. BRAIDWOOD said that, though inoculation was most necessary, and its influence most potent, in the case of low-carbon irons, he had found the procedure to be of benefit when applied to high-phosphorus irons of the commercial type also. At the present time he was obliged to pour miscellaneous castings in a 1.2 per cent. phosphorus iron, and trouble had been encountered in the form of "draws." Inoculation of the iron, by the simple process of floating lump electrode in each vessel, had brought about marked improvement in foundry results. (For a full account of this procedure see the report in last week's issue of the discussion which followed the Manchester meeting.)

With high-steel charges, the sulphur pick-up on melting could be considerable, but, as would be seen from the tables, the final sulphur contents of the high-duty irons described were generally below 0.1 per cent., and were very often much lower. Phosphorus contents were, of course, very low, due to the nature of the charged materials.

MR. R. R. SHAW (Larbert) said he was interested in Mr. Braidwood's contention that steel in the cupola melted as such. In what zone of the furnace did such melting take place? With regard to the higher impact values of the inoculated irons, were these entirely due to alterations in the form of the graphite? Was it not possible that the improved results were attributable, at least in part, to modification of the matrix?

* See "Foundry Trade Journal" for May 14, pp. 21-28.

Conditions in the Cupola

In reply to the first point, MR. BRAIDWOOD described in detail the ingenious experiments of those authorities to whom reference had been made in the Paper, and, with the aid of blackboard sketches, indicated his conception of the situation existing within the cupola during the melting of steel. He pointed out that such material must melt nearer to the zone of maximum temperature than did cast iron, and stressed the necessity for maintenance of an adequate bed. The improved impact values found to result from inoculation of the irons described were undoubtedly due entirely to the marked alterations effected in graphite form and mode of distribution. The respective sets of test-bars were uniformly pearlitic.

MR. TYRIE invited the lecturer to describe the types of castings normally poured in the high-duty irons described and to indicate those principles of gating, etc., which had been found most suitable. He was interested in Mr. Braidwood's technique of inserting extra coke charges at intervals, and he asked if this practice was recommended for all cases in which steel scrap formed a substantial part of the charge.

In reply, MR. BRAIDWOOD discussed the characteristic defects to which low-carbon irons were prone, and outlined the means by which these might be prevented. He emphasised that there was nothing in the production of high-duty iron castings to worry any go-ahead foundryman, who was prepared to adapt his technique intelligently. The essentials were the promotion of progressive directional solidification and the provision of adequate feeder heads. (For a more complete statement on production technique, see the Manchester discussion, *loc cit.*)

The insertion of extra coke charges at proper intervals was a practice which should be followed wherever appreciable proportions of steel scrap were incorporated in the cupola charge. At Renfrew, this was routine procedure in the daily, bulk production of good-quality irons, satisfying Specification 786, Grade 2, and prepared by the melting of pig and steel charges. If ordinary irons were required to follow, the provision of a generous coke layer on top of the ultimate steel-containing charge, was especially recommended. This had the

Cupola-Melted High-Duty Cast Irons

effect of restoring the bed to normal height and also promoted sharp separation of the respective grades of iron.

Written Contributions

MR. J. G. PEARCE, Director of the B.C.I.R.A., and MR. H. MORROGH, Metallographist to the Association, also spoke at Falkirk, and the lecturer made a full reply. By common agreement, the speakers have since put their remarks in the form of a written contribution to the discussion, and Mr. Braidwood has prepared a considered reply, all as follow:—

MR. J. G. PEARCE wrote that this admirable Paper confirmed that any foundry with the will and the ability to exercise control in its operations can make high-duty cast irons, and the foundry doing so is indeed fortunate if it has available rust-free steel scrap of suitable section. In general, he could fully confirm the author's points, particularly those relating to melting practice, although the experience of the B.C.I.R.A. was that the stated manganese losses in briquette melting were on the high side. He found them roughly similar to those of silicon. He urged the author to specify the type of pyrometer he used and whether the figures were or were not corrected. Mr. Morrogh, in a parallel contribution, had dealt with the question of nomenclature of graphite and had made out a case against the use of the term "random" graphite. However randomly distributed it appears to be, it was preferably termed "normal," since the distribution was never really random. It was difficult to understand the author's objection to the use of the term "supercooled," or, as it was preferably called, "undercooled" graphite, which had been used by the B.C.I.R.A. since 1928. Advice to secure fine graphite referred, of course, to fine flake graphite and not to under-cooled graphite.

Since the B.C.I.R.A.'s recommendations regarding a single blow impact test, using a 0.875-in. cylindrical, machined, but unnotched bar were put forward in 1939, a good deal of work had been done with the object of using the 1.2-in. bar, which is probably in more general use than the 0.875 in. Unexpected difficulties had been met. Did the author experience a double or multiple blow on his impact bar, evidenced by marks below that of the original blow, and, if so, did he consider that the results were thereby affected? Did he consider the test in its present form sufficiently satisfactory to standardise?

While the present writer shared the author's admiration for much of the metallurgical work done in the United States, it may be appropriate to recall that in 1929 Norbury* showed that cast irons of identical compositions could have entirely different structures, one of normal and the other of under-cooled graphite. The under-cooled graphite iron was darker in colour and denser in structure, was softer and more machinable than normal graphite iron of the same composition. Frequently, at that time, both structures occurred in the one piece of metal and the mechanical properties of these mixed structure irons were inferior to those given by either structure exclusively. The undercooled structure was shown to chill more readily and yet, when grey, to be associated in the final structure with ferrite rather than with pearlite. The structure found commercial application in Silal and Nicrosilal heat-resisting irons, and more recent work has shown its remarkable freedom from shrinkage and unsoundness in compositions which with normal graphite would be expected to show shrinkage. Undercooled-graphite irons made from the same pattern were invariably slightly smaller than normal graphite irons, and hence were slightly denser. There was a general tendency to condemn the undercooled graphite structure on the ground of its greater rigidity, poorer mechanical properties, poorer wear-resistance, *e.g.*, in brake drums, but an attitude of general condemnation was to be deprecated. In many cases, a compromise had to be made between the properties of castability, soundness and mechanical strength.

Undercooled Structure Long Known

The undercooled structure was not new in itself. It had been observed in old photomicrographs, was frequently found in commercial irons, and its formation was fostered by superheating or rapid cooling. Norbury pointed out the analogy between these normal and modified (undercooled) cast irons and the ordinary and modified aluminium-silicon alloys, and doubtless one explanation would serve for both. These alloys, incidentally, had to be undercooled in order to be modified, but undercooling did not necessarily result in modification. The eutectics containing undercooled graphite undoubtedly solidified at a lower temperature than the normal graphite eutectic and in a later Paper,† Norbury and Morgan dealt with the effect on graphite structure of the use of steel in the charge and of ferro-silicon and other ladle additions. The undercooled-graphite structure had been referred to above as "modified." There was some risk of confusion in the use of the term "modified" to treatment by ladle graphitisers, or inoculation.

* Journal, Iron and Steel Institute, 1929, I.
† Journal, Iron and Steel Institute, 1930, I.

Cupola-Melted High-Duty Cast Irons

Up to 1936 no positive method of producing these structures throughout cast iron was known, for superheating and chilling were uncertain in their effects, but the now well-known titanium/carbon-dioxide process* evolved by the B.C.I.R.A. accomplished this, even in very heavy sections and from cupola-melted material, but its further development had been interrupted by the war.

Mechanism of Graphite Formation

Apart from any industrial use of these undercooled-graphite irons, the subject had considerable bearing on the mechanism of graphite formation. The graphite nucleus theory, so wholeheartedly embraced in some of the U.S. Papers referred to, had not been supported in this country to any extent since 1930. One could not argue that graphite dissolved readily at temperatures just above the liquidus and postulate a shower of graphite particles on adding an inoculant. Following the recognition of the ready solubility of graphite at molten metal temperatures, attention was drawn to the possible nucleating effect of non-metallic inclusions, although it was recognised that nucleation required the introduction of particles of similar crystal structure to those about to be precipitated. More recently, a good deal of work had been done on the determination of the nature and quantity of non-metallic inclusions, and a number of pig-irons had been examined by the B.C.I.R.A. by chemical methods for oxide inclusions. The amounts present were so small as to make them a very speculative basis for theory. Furthermore, Mr. Morrogh, as a result of exhaustive microscopic examination, had failed to find the presence in ordinary cast irons of oxides of iron, manganese or aluminium, or of the silicates which would be revealed by chemical methods as oxides. Thus, any inclusions must, if they were there at all, be sub-microscopic or be dissolved in the metallic matrix or in the admittedly more extensive sulphide inclusions. On the other hand, entrained slag, moulding sand or oxide resulting from overheating cast iron were readily seen under the microscope.

However, it was fortunate that practice did not need to wait for a full explanation of the obscure mechanism of graphite formation. The metallurgist required to be able to control the amount of undercooled or normal graphite, which was possible, as the Paper indicated, by the use of what the B.C.I.R.A. originally termed "inoculants," because the effect was so out of proportion to the quantity used. Many substances had now been tried for these purposes. The term had been widely used, both here and in the U.S.A., and had also been criticised, but no more suitable term had been suggested, although the word "nucleation" might prove to be satisfactory. The term "graphitiser" might be misleading, for the inoculant prevented the formation of undercooled graphite, and the accompanying disadvantages of the mixed structure, without appearing to influence the amount of distribution of the normal graphite. Any explanation of the effect of an inoculant must have regard to the fact that the structure of an inoculated iron was, any differences in composition being allowed for, not distinguishable from that of a non-inoculated iron. How could this be reconciled with the suggestion that in the one case a shower of graphite particles was produced? On the other hand, why should graphite-free scrap and charges be so desirable? The subject was packed with unanswered questions.

* Journal, Iron and Steel Institute, 1936, II.

Terminology of Fine Graphite

MR. H. MORROGH wrote the author had presented in this Paper information of both urgent practical and theoretical interest. He should be congratulated, firstly, as a foundryman and, secondly, for the extremely stimulating manner in which the results of his experiments had been presented.

The author discussed the terminology of fine graphite formed in grey cast iron by undercooling of the melt. This type of structure had been variously referred to as supercooled, dendritic, abnormal, eutectic and eutectiferous, as the author pointed out. Dismissing these terms as either being not strictly correct or actually misleading, the author substituted the word combination "grain-boundary-graphite," claiming that it was the most accurate description so far applied, and on account of the cumbrous nature of this preferred to use the term "reticular-graphite." It was a personal opinion that this term was no better than any of the others. In view of the fact that no satisfactory term for this type of structure existed, and since a large number of various terms were in use, which, like the author's, were either misleading or incorrect, it was worth while to examine the possibility of formulating a more accurate and disciplined terminology.

First, it was necessary to examine the mechanism of solidification of a grey cast iron. Ordinary commercial cast irons had a complex constitution, and strictly they must be considered at least as ternary or quaternary alloys. When a grey cast

iron solidified the first solid phase to form was austenite, which was deposited from the melt in the form of dendrites. As solidification proceeded the melt reached a composition and temperature when it was simultaneously saturated with both austenite and graphite. These two phases were then deposited simultaneously in the form of a binary complex. Strictly speaking, it was incorrect to refer to this complex as a eutectic since the alloy was complex and the duplex structure might be formed over a range of temperatures, and over a range of composition, and furthermore it did not possess the lowest melting point of the constituents or phase combinations present in the solidified alloy. Normally the graphite of the binary complex was in the form of relatively large flakes or lamellæ, but undercooling could occur and then the graphite was formed in a very finely divided form. Thus far the significant facts arising from this discussion were that it was incorrect to use the term eutectic, although since the binary complex solidifies in a manner similar to that of a eutectic it was justifiable to use the term "eutectiferous." It is also seen that in an ordinary grey iron the graphite complex was formed after the primary austenite dendrites and were distributed around the dendrites. Thus the term dendritic was obviously incorrect, while the terms extra-dendritic and inter-dendritic quite correctly describe the structural position of graphite in cast iron of ordinary commercial compositions. However, neither of these terms differentiated normal long flake graphite and the fine graphite formed by undercooling. Both of these graphite forms were inter- or extra-dendritic, and in this sense they were both the same, that is, they were both formed after the austenite and around the dendrites.

Dendritic Structure

That ordinary flake graphite is inter-dendritic was a fact which was not generally appreciated or understood, and doubtless this misunderstanding had led to the conception of "random" graphite and "dendritic graphite." In low carbon irons, that is, irons with less than 2.7 per cent. carbon, both normal and undercooled structures showed graphite which was manifestly formed between dendrites. This clarity was due to the fact that the primary dendrites occupy a relatively large proportion of the total metallic matrix. In the case of the higher carbon (3 to 3.6 per cent.) commercial alloys, the binary complex occupied a very large part of the structure, and since the metallic phase of the binary complex was continuous with the primary dendrites in the transformed structure at room temperature the primary dendrites tended to become masked. By suitable etching technique, however, the primary dendrite structure could be revealed and the primary dendrites could be seen to have the graphite surrounding them. Boyles* had shown some very convincing micrographs of flake graphite forming between the primary dendrites.

A further factor contributed towards the mode of distribution of the graphite, and that was the pouring temperature. Norbury† had shown that the higher the pouring temperature of a given alloy the fewer and longer become the primary dendrites, the higher the pouring temperature the dendrites became more columnar. With lower pouring temperatures the primary dendrites increased in number and became more equiaxed. These were general laws applying to all alloys, including cast irons. Now it had already been shown that the graphite in cast iron, whether of the normal or undercooled variety, was positioned around the primary dendrites, and thus the form and size of the primary dendrites influenced the distribution of the graphite. (It was important to note that it was the distribution of the graphite and not the size of the graphite flakes which was the present concern.) It followed that the pouring temperature would also affect the mode of distribution of the graphite. With high pouring temperatures when the dendrites were few and long the graphite tended to be arranged in definite planes following the arms of the primary dendrites. With low pouring temperatures when the dendrites were more equiaxed the graphite tended to assume a more random arrangement, but the distribution of the graphite was still determined by the primary dendrites.

Effect of Pouring Temperature

This effect of pouring temperature was most marked in low carbon irons, where the proportion of primary dendrite in the microstructure was high. The effect was least marked in high carbon irons where the proportion of primary dendrite in the microstructure was low. Thus for all irons the tendency to give random distribution of graphite was most marked with low pouring temperatures. Pouring temperature was, of course, a purely relative expression, and low pouring temperature really meant a small temperature interval between the pouring temperature and the freezing point of the alloy. A high pouring temperature for a high carbon cast iron might be a low pouring temperature for a low carbon alloy.

* Transactions, A.F.A., 1938, Vol. 46, p. 297.

† Journal, Iron and Steel Institute, 1939, No. 11, p. 161.

Cupola-Melted High-Duty Cast Irons

The fine undercooled graphite followed the outlines of the dendrites in exactly the same manner, but the primary dendrites tended to be more obvious, because the metallic phase of the binary complex was more finely dispersed and was thus clearly distinguished from the primary dendrites. It followed from this that the only fundamental difference between the two types of graphite under consideration was the temperature of freezing or the extent of undercooling. From this it then followed that the only suitable term for the very finely dispersed graphite was "undercooled" graphite, and for the coarse form "normal" graphite. The term "normal" was used here to indicate the fact that the iron had solidified according to the ordinary conditions of stable equilibrium and that no undercooling had occurred.

From the foregoing it was seen that the author's term "reticular" (that is, resembling a net) was by no means an accurate description of the mode of distribution of the undercooled variety of graphite. The constituents which solidified after the binary complex certainly were reticulated, hence the term "phosphide network," but this applied to both normal and undercooled structures. The phosphide eutectic was always present in the form of a network in ordinary grey cast iron, regardless of whether undercooling occurred or not. This was because the binary complex solidified with spheroidal crystallisation front, and the lower melting point constituents were pushed towards the interstices of these binary complex spheroids. This spheroidal form of crystallisation characterised all binary eutectics and binary complexes irrespective of undercooling. Thus it was seen that the phosphide eutectic is distributed in the form of a net and not the binary complex. The binary complex merely filled in the interstices of the primary dendrites.

Cause of Graphite Distribution

Following the argument showing that since normal flake graphite was arranged around the primary dendrites, and since the distribution of the primary dendrites was a function of pouring temperature, it was interesting to observe that ladle inoculation was not responsible for the so-called random arrangement of graphite. Ladle inoculation with calcium silicide, ferro-silicon and electrode carbon prevented the formation of undercooled graphite, but in no way determined the mode of distribution of the normal graphite formed by this treatment. The final controlling factor deciding the distribution of this graphite was the pouring temperature. The higher the pouring temperature the weaker the iron tended to become, due to the formation of a pronounced and regular graphite pattern following the outlines of the primary dendrites. With lower pouring temperatures as the dendrites become more equiaxed, the graphite flakes tended to assume a more random type of arrangement. However, the arrangement was never truly random, and it was governed entirely by the distribution of the primary dendrites, and hence by the pouring temperature. It follows from this that, if a random graphite pattern was considered to be a criterion of good mechanical properties, then the aim should be to cast the metal at the lowest temperature consistent with being able to run the casting and avoid blowholes.

(*To be continued.*)

DELAY IN MAGNETIC RESPONSE

A steel strip that, when placed under a powerful magnet, waits about 90 secs. before it jumps toward it, is used by Dr. H. H. Uhlig, of the American General Electric Research Laboratory, to show a delayed change in the steel's atomic arrangement. Exact knowledge of the nature of such changes is important in making magnetic materials for transformers and other electric equipment. The strip is a common type of 18/8 stainless steel and is not ordinarily attracted by a magnet, because it usually contains a little nitrogen. This stabilises the non-magnetic condition of the metal that occurs at temperatures above 1,470 deg. F. The nitrogen seems to cause friction, which prevents the atoms from rearranging themselves to the phase in which a magnet causes attraction.

If a piece of the nitrogen-free metal is heated to 1,100 deg. F., then cooled, the magnetic phase does not return until it is down to the boiling point of water, 212 deg. F. Dr. Uhlig found that if the heated strip is suddenly cooled by quenching in water, then placed under the magnet, it is not attracted, even though it is cooler than the temperature at which the change should occur. After about a minute and a half, however, it suddenly jumps to the magnet. Dr. Uhlig says that the atoms start rearranging themselves as soon as it is cooled, but it takes this time before a majority are shifted and at least a day before all reach a state of equilibrium. From these experiments it is hoped to learn more about the heat-treatment of steels and the preparation of alloys with better mechanical properties and corrosion resistance.

Economising in Manganese.—The American steel industry is now saving 1 lb. of ferro-manganese for every ton of steel made, stated Dr. A. Leith, technical consultant, WPB, at the recent annual meeting of the American Institute of Mining and Metallurgical Engineers. Current stocks of manganese are ample.

INSTITUTE OF BRITISH FOUNDRYMEN

Birmingham, Coventry and West Midlands Branch

The annual general meeting of members of the Branch attracted a good attendance to the Birmingham Chamber of Commerce on May 29, when, in spite of war difficulties, an increase in membership was reported. Reviewing the year's activities of the Branch, Mr. A. A. Timmins (hon. secretary) thought that, despite the difficulties with which they had been faced, they could look back upon the work done with a fair amount of pride. Their experiences during the previous winter due to the black-out, raids and transport difficulties, led the Branch Council to deem it undesirable to hold meetings during the winter and to favour an extension of activities during the spring and early summer. As it happened, however, they could have held meetings last winter in safety, but they had not lost much by holding them during the period of lighter evenings. During the past session six lectures had been held, the average attendance being 38. Two outstanding attendances could be noted, *viz.*, 68 for the Paper by Mr. R. Webster (U.S.A.), on "Sand and Water Cleaning Process and Sand Reclamation," and 54 when Mr. J. G. Pearce gave a lecture on "High-Duty Phosphoric Irons." In June, the Branch held an informal dance, when some 90 members and their ladies, he believed, spent an enjoyable time. With regard to membership, that now stood at 344, representing a net increase of five. During the year 19 new members had been elected, but they had lost 14 by resignation and deaths. Among the latter should be recorded the loss of that well-known figure and past Branch-President, Mr. F. J. Hemming. Financially, the Branch had had a very successful year. The subscription income of £529 19s. was a record, while expenditure amounted to £105 2s., compared with £113 3s. 3d. the previous year. He assured members that the Branch Council intended to do everything in its power to maintain the activities of the Branch, despite the difficulties which lay ahead, and in conclusion he wished to thank the Council, and particularly the Branch-President (Mr. N. C. Blythe) for their loyal co-operation during the past year. On the proposition of Mr. A. J. Shore, the secretary's report and the statement of accounts was accepted.

Election of Officers

In proposing that Mr. T. H. Gameson should succeed him as Branch-President, MR. BLYTHE reminded members that the former had been Senior Vice-President for the past two years. Mr. Gameson was extremely well qualified to fill that office. This was briefly seconded by Mr. W. B. Parkes, and carried with acclamation.

Acknowledging the honour, Mr. Gameson remarked that Birmingham was one of the oldest Branches, and assured all that he would do his best to live up to the high traditions created since its inception. Thanking Mr. Blythe for what he had done for the Branch during his two years of office, Mr. Gameson said the period had not been a cheerful one owing to wartime difficulties. They were, however, extremely grateful to him for all he had done.

MR. J. J. SHEEHAN was elected senior vice-president, and the meeting readily accepted the Council's nomination of MR. G. R. SHOTTON as junior vice-president. Mr. A. H. Harrison, Mr. E. C. Dickenson and Mr. T. H. Taft were re-elected members of the Branch Council.

Mr. Sheehan, Mr. L. W. Bolton and Mr. N. C. Blythe were elected delegates to the General Council, and Mr. Bolton and Mr. Shotton were re-elected delegates to the Technical Council. The hon. secretaryship will continue in the hands of Mr. A. A. Timmins.

"Mass Production of an Alloy Casting"

At the conclusion of the business of the annual general meeting, Mr. J. W. Gardom gave an illustrated lecture on "The Mass Production of an Alloy Casting." Mr. Gardom described the layout of foundries which had been designed and built for the mass production of a single casting. The whole of the plant and equipment had been arranged so that the maximum amount of women labour could be employed. A method of coremaking had been developed so that satisfactory cores could not only be made by unskilled labour but also set in the moulds with speed by unskilled girl core setters. Certain special equipment, as, for example, a mould lift-off device, had been developed to enable girls to handle the moulds from the machines. The weight of half moulds which had to be transferred from the machines was approximately 2½ cwts.

Mr. Gardom went on to discuss the general question of mechanisation and explained why some foundries in the scheme had not been completely mechanised. He likened the ideal layout for complete mechanisation to a river, in that although the rate of flow varied considerably in different parts, the volume passing remained constant and incidentally never stopped. He explained that the lakes found in the course of most large rivers showed that storage capacity was essential for continuous movement and the whole layout must have complete flexibility, though it was admittedly more difficult to push materials back against the flow than for them to travel with the current. The Paper was illustrated by a number of slides showing the various types of plant used for mass producing an alloy casting.

Shortage of Engineers.—R. E. McConnell, engineering consultant, WPB, and chairman, Engineers Defence Board, stated at the recent annual meeting of the American Institute of Mining and Metallurgical Engineers that "the greatest shortage of all" is the shortage of engineers. During the 1914-18 War, seven men were required to support each man at the front: to-day, he said, 17 men are required. He estimated that there is a shortage of 1,000,000 engineers and technically-trained men, and urged that the present force be used as effectively as possible.

BACK THE R.A.F. WITH YOUR WASTE PAPER

MOULDING AND CASTING A 6½-TON CRUSHER SHELL

By C. NORBURY and J. M. STONES

Paper read before the South African Branch of the Institute of British Foundrymen

The moulding and casting of this crusher shell proved a most interesting and complicated affair. To make the pattern necessitated a fair amount of thought and close co-operation between pattern and foundry foremen. It was at first suggested that the mould be made by building up in brick and strickling in loam, but, as this casting was urgently required, it was finally decided that a full pattern be made to eliminate as much time as possible in the foundry; another consideration was that other orders were pending, and more than one would have to be made.

Preparation of Mould

Primarily a pit was dug in the foundry floor, 5 ft. deep by 10 ft. square, a 10-ft. cope box being placed at the bottom of the pit with long 1¼-in.

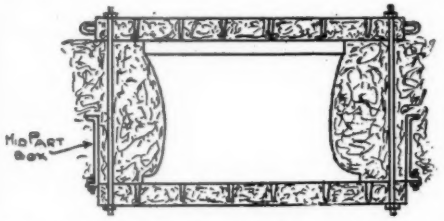


FIG. 1.—METHOD OF BOLTING COPES TO RELIEVE PRESSURE AND WEIGHTING OF MOULD.

bolts attached to each corner, and made so as to come level with the top cope. By this means, the two could be bolted together and thus relieve the weighting of the mould. This would also ensure that, when the bottom box was rammed up with sand, it was solid and strong to withstand the great pressure of metal which occurs at the bottom of a mould of this type.

On top of this bottom box a bed was strickled out for the pattern. As a further precautionary measure against pressure, a mid-part box was bolted to the bottom of the box, which enclosed practically half the pattern. After the bottom cope box was rammed up and the bed for the pattern strickled, the pattern was placed on the bed, and cores were placed round the pattern to form the bottom flange and brackets as shown in Fig. 2. Twelve cores were required. The pattern was then rammed up level. This casting was poured from both sides of the mould (Fig. 3), a 6-ton and a 2-ton ladle being used.

Cores

The cores played an important part in the success of the casting. The bottom shute and outlet core were made from a half-core box (right- and left-hand). The necessary core irons (Fig. 4) were made in a level bed, by forming a mould from a corebox, allowing for bolt holes, and then covering this mould by means of a very old-fashioned method—by using thick brown paper, sand being placed on this paper and weighted down. Making the core irons this way resulted in a saving of hours of work, because if the core irons had been made in moulding boxes, the time spent in so doing would have been tripled.

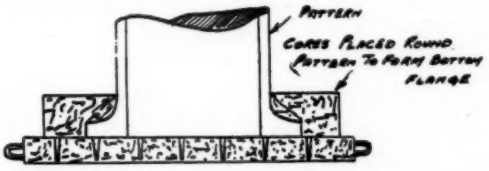


FIG. 2.—PATTERN USED SHOWING FLANGE FORMATION.

The two halves of this core were then bolted together when dry, a piece of piping being placed over the bolt at the two outlet ends to act as distance pieces, as shown in Fig. 5.

The top shute core iron also presented considerable difficulty, necessitating a frame being made so that the iron could be made in a level bed. The core was made in two sections, the bottom section all in one, while the three top cores were made separately, and placed on top of the main core. The bottom section core iron was as shown on the sketch. The corebox for this was made so that the three top cores were rammed up first and jointed; then the main core was rammed on top, lifted off, and turned over by means of beam and slings, when dry; then it was again lifted up by means of the three toes and placed on trestles in

position, for the top cores to be put in place.

The venting of these cores was very important, and vents were brought off in each case to the outside of the mould by means of shute outlets. The core sand used in the making of these cores was of a very open texture, being two parts river sand to one of clay, and bonded with molasses to withstand handling and turning over of cores. The assembly of cores in the mould took two days to complete, the lifting holes in the cores having to be dried, and the job made up and cast on the third day.

DISCUSSION

The PRESIDENT (Mr. J. Tonge) said that the authors had shown once again that necessity was

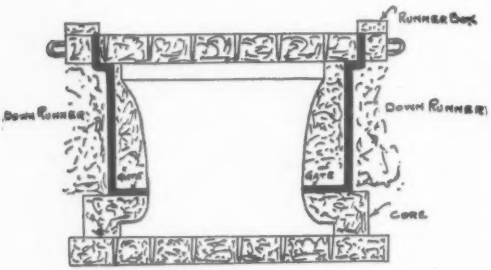


FIG. 3.—METHOD OF POURING.

the mother of invention. South African foundrymen could be very proud of being able to cope with jobs of this nature without the tackle which was familiar overseas. He held the opinion that foundry problems were tackled more fully in South Africa than overseas. In his view, South African castings compared very favourably with overseas products. He questioned if people appreciated the difficulties with which the foundrymen were faced in a young country, and it was very much to the credit of members that they were able to produce intricate castings of such high quality. Finally, he asked whether any trouble was experienced with boxes breaking away. He suggested that for a cast-iron job weighing 6 tons, the floor should have been prepared to take that weight.

MR. LION-CACHET congratulated Mr. Norbury on his clear explanation of the difficult job that had been executed. What particularly impressed him was that the full pattern had been made. This was the modern outlook. It was so often thought that the quickest way was to make the strickle and a few coreboxes and leave the rest to the moulder. From long experience he was of opinion the authors had done the right thing in making the pattern. The ability of the moulder came more to the fore when a full pattern was available.

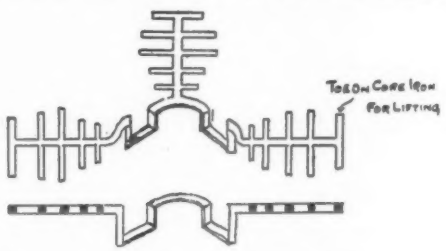


FIG. 4.—MAIN CORE IRON FOR TOP SHUTE CORE.

Judging from the photographs which had been passed round, this had been a very difficult job. He considered that a foundry making a casting of this nature should notify the Branch, in order that local members might have an opportunity of inspecting it. He then referred to the co-operative spirit which the Institute had brought about, and which to his knowledge had never previously existed in the South African foundry industry.

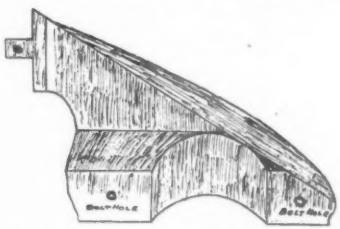


FIG. 5.—SKETCH OF HALF CORE SHOWING BOLT HOLES BY WHICH THE TWO HALVES WERE BOLTED TOGETHER.

Under present conditions foundrymen were faced with jobs involving problems of such magnitude that under normal circumstances they would not be accepted. To-day they were forced to undertake such jobs for the well-being of the United Nations. Finally, he asked why the casting had been made. Was it to replace a broken casting, and what had been done to prevent a repetition?

Moulding and Casting a 6½-ton Crusher Shell

MR. NORBURY said that the pattern was made from a sample which was broken at the bottom shute core. He understood that this casting supported most of the machinery of the crusher itself, the actual crushing being done by means of an eccentric shaft located above.

The PRESIDENT then suggested that the casting might preferably have been made of steel, since a certain amount of shock had to be withstood.

MR. LION-CACHET said he was convinced that the correct material was cast iron, which was generally used for this purpose on the Reef.

MR. STONES said that it had been originally intended to strickle up the outside and brick up all the cores. Breaks, such as happened in this casting, in his opinion, were due to contraction strains after casting. In order to minimise the risk of cracking, it was ultimately decided to use sand cores. The packing of the core crown and core-boxes was a considerable undertaking. The mould itself could have been strickled quite easily instead of making a pattern, but no saving would have resulted, as the job was rammed up in a couple of days with a pneumatic runner. Setting cores was a difficult operation. The easiest method of moulding would have been by casting the square flange at the bottom, but as the round flange which has to take most of the strain should be sound, it was decided to adopt the more difficult method and try to produce a sound casting. The taper pin was actually moulded upside down so as to get the compression into the solid part of the castings. An interesting point in connection with the job was that, due to weather conditions, the foundry's big cupola was out of action, and only a 24-in. cupola was available. In order to be certain of having a sufficient quantity of metal, about 8 tons were necessary, and it was by no means easy to get this quantity of metal through a 24-in. cupola.

MR. LION-CACHET asked Mr. Norbury whether he had copied the method by which the original casting had been made or whether a completely new method had been devised to meet the circumstances.

MR. NORBURY said that the system adopted had been worked out by Mr. Stones and himself in consultation with the patternmaker.

MR. TONGE suggested that the method chosen called for little criticism. When any individual foundry was asked to make a casting of this nature, the particular circumstances had to be taken into consideration and a suitable method improvised.

CASTING PIT REFRACTORIES

Iron and Steel Institute Special Report, No. 28, gives an account of recent work on steelworks refractories carried out under its aegis. Investigations on silica bricks have developed from a general survey to an intensive study of one roof, while work on basic refractories has ranged from fundamental studies on the constitution of stabilised dolomite and chrome ores, to the preparation of test-sheets for the service testing of basic refractories in the open-hearth furnace. Casting-pit refractories have several times been discussed in somewhat general terms, but now a sub-committee has been formed to deal with this side of the work.

The work of the Open-Hearth Refractories Panel on casting-pit refractories has developed considerably, states the Report. Plant work was carried out prior to the war to determine the factors which influence the life of ladle linings; this investigation has entailed the correlation of a considerable amount of data. Preliminary reports have been discussed by the Panel and the final detailed account of the work has now been completed. The Panel has also obtained a number of "Dando" American ladle bricks; these have been tested by the B.R.R.A. The bricks were notable for their perfect shape, low porosity (13 per cent.), low refractoriness (1,520 deg. C.), and extraordinary bloating on firing to a temperature of 1,400 deg. C. (permanent expansion of 34 per cent.).

The problem of the detection of refractory inclusions in steel, and the types of brick most liable to give rise to such inclusions, has also engaged the attention of the Committee. The method which it is proposed to use was first suggested by R. B. Sosman. The suggestion was made that by impregnating the casting-pit refractories with a radio-active element, any inclusions arising from erosion of the refractories could be detected by their radio-active properties. Dr. Vickers (I.C.I., Limited) had had experience in the use of this method of tracing small quantities of a substance, and Dr. Rees and Dr. Chesters collaborated with him in working out the preliminary details for an experiment to be made. The staff of the Physics Department of Sheffield University (Dr. Lawson assisted by the late Dr. Wilde) then helped in this work, and a set of casting-pit refractories is now being made preparatory to carrying out an actual test on a cast of steel.

A report on casting-pit refractories as a source of non-metallic inclusions in steel was presented to the British Ceramic Society by Dr. Rait (Messrs. Wm. Jessop & Sons, Limited) in September, 1941. A condensed report on the same subject has since been considered by the Open-Hearth Refractories Panel, which decided that the time was ripe for the setting up of a sub-committee to deal exclusively with casting-pit refractories. This sub-committee has held two meetings and has mapped out a considerable programme of work, including a survey of the range of sizes of casting-pit accessories now being produced. This survey is being made with a view to eliminating redundant sizes.

MAGNESIUM FROM DOLOMITE

A new method for the manufacture of magnesium uses ferro-silicon to reduce calcined dolomite to free metallic magnesium which is then distilled from the reacting mass. Production of the light metal in the United States has so far been limited to the electrolysis of magnesium chloride obtained from natural brines and from sea water together with small amounts from the Hansgirg process based on the reduction of calcined magnesite with carbon.

A new ferro-silicon process has been developed by L. M. Pidgeon, of the Canadian National Research Council. Pidgeon found that the reaction between ferro-silicon and magnesium oxide proceeds smoothly at practicable temperatures under vacuum in the presence of calcium oxide. Metallic magnesium distills readily at the reaction temperature and condenses in extraordinary purity as a crystalline lining in a condenser tube connected with the reaction retort.

The process consists of briquetting ground ferro-silicon (75 per cent. or higher silicon content is preferred) with dead burnt dolomite and heating these briquettes in an alloy steel retort to about 1,150 deg. C. The retort is constructed with an integral condenser tube into which a removable, tubular steel lining fits. The retort and condenser are evacuated to low pressure (a fraction of a millimetre), and as the reaction proceeds, pure metallic magnesium condenses in the lining of the condenser. At the end of the run—including time for evacuation, the cycle is about 6 hrs.—the condenser liner is removed with its accumulated magnesium. Differential contraction of the steel and magnesium breaks the two apart and the magnesium "pipe" is ready to go to the foundry without further purification or treatment. The retorts used resemble those of the zinc industry and can be heated in any convenient manner, using gas, coal or electric heat.

Amongst the advantages claimed for this process are that the process equipment is comparatively simple: cast alloy steel retorts which embody a minimum of machine finishing, furnaces for heating the retorts, and vacuum pumps to evacuate them. Dolomite is plentiful and easily calcined in standard lime-kiln equipment. Ferro-silicon is made in America on a huge scale in standard electric furnace equipment from plentiful raw materials. The reaction proceeds smoothly without hazard. No evolution or handling of gases is involved, and when the retorts are opened, the magnesium is in solid massive form precluding the possibility of explosion or fire. Special emphasis is placed on the relatively low investment in plant required and on the speed with which units can be built in the present emergency. Furthermore, pilot plant operation to date has amply proved the process, and construction of production plants is already under way.

Several companies have become actively interested in putting this process to work. In Canada, Dominion Magnesium, Limited, is operating a pilot-scale plant. This operation is in process of being enlarged to 10 tons per day. The process depends on the simple reaction between magnesium oxide and elementary silicon contained in ferro-silicon:—

$$2MgO + Si = 2Mg + SiO_2.$$

Subsequent reaction between the SiO_2 formed and the calcium oxide of the charge forms infusible dicalcium silicate that can be easily removed from the retort at the end of the run without slagging. No gas is evolved or involved in the process. Based on this reaction, each pound of silicon in the charge should theoretically produce 1.73 lbs. of metallic magnesium. In terms of 75 per cent. ferro-silicon, each pound of magnesium produced requires practically 1 lb. of alloy.

The simplicity of the operation depends further on the fact that a powerful reducing agent, ferro-silicon, is supplied to the process. This must be manufactured elsewhere, and although the raw materials required for it are plentiful, the energy needed is high and the demand for the product by the steel industry is great.

Production of ferro-silicon of all grades in the United States in 1940 was 406,699 net tons. The average silicon content of this entire output was 28 per cent. Included in the total are alloys containing as little as 7 per cent. and as much as 95 per cent. elementary silicon. The lower grades were produced in blast furnaces whose total output was 190,310 tons. Electric furnace operation supplied 219,141 tons of higher concentration alloys and 248 tons were produced as a by-product of electric furnace abrasives. Present rate of production is over 700,000 tons per annum.

Because of the need for ferro-silicon in war work, the present fixed price ceiling for the 75 per cent. grade is $135 per net ton. On this basis and assuming that ferro-silicon of the required grade is available in sufficient quantity, the cost of magnesium by the Pidgeon process should be well below the present market price of 22.5 cents per lb.

When these facts are considered with the obvious advantages of the process and the further consideration that the operation can be carried out in relatively small and widely distributed units, the desirability of utilising ferro-silicon as a reducing agent with dolomite in the expanded magnesium programme at once becomes patent.

[Extracted from "Chemical and Metallurgical News."]

Check-Analysing Alloys

Using a new form of thermocouple, the Identometer produced by Metals Research Apparatus, Inc., Pittsburgh, makes a very rapid check-analysis of metals and alloys. The instrument is simple in construction and operation. Exhaustive tests on the common ferrous alloys have demonstrated that the Identometer is consistent in detecting even very small differences between two alloys. Two samples of a seven-element alloy were tested, both having been reported by chemical analysis as having the same composition except that in one the copper content was 0.05 per cent. and in the other it was 0.22 per cent. This variation was detected immediately.

STANTON *Dale* REFINED PIG IRON

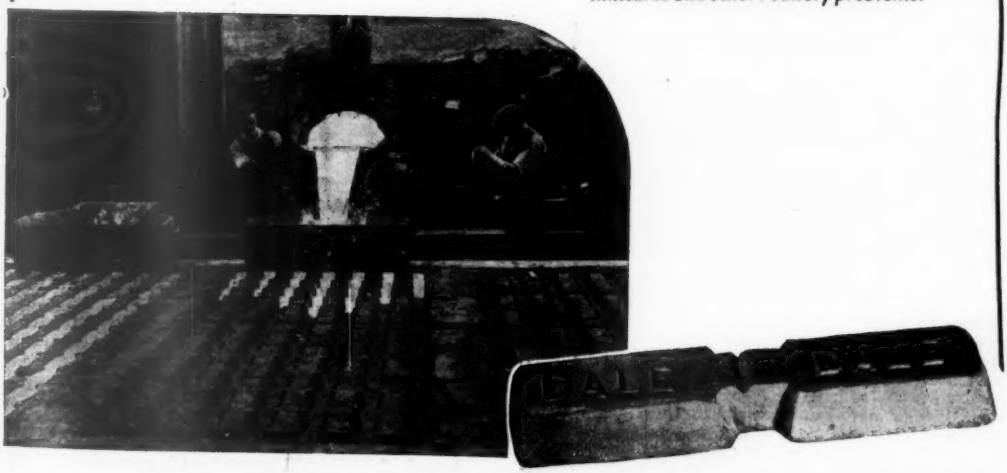
IS CHARACTERISED by closeness of grain structure, uniformity of composition and fine graphitic carbon evenly distributed.

IS PRODUCED to guaranteed analysis in seven standard grades.

CAN BE MADE to customers' individual requirements with total carbon from 2·6 per cent. upwards.

SHOULD BE USED to tone up high phosphorus irons and scrap, to replace Hematite, and to produce castings for all high duty purposes.

Users are invited to avail themselves of the Stanton Technical Service which offers free expert advice on special mixtures and other Foundry problems.



THE STANTON IRONWORKS COMPANY LIMITED, NEAR NOTTINGHAM

NEWS IN BRIEF

MR. GAVIN MARTIN has been elected general secretary of the Confederation of Shipbuilding and Engineering Unions in succession to the late Mr. E. Gilbert.

THE UNIVERSAL SYSTEM OF MACHINE MOULDING & MACHINERY COMPANY, LIMITED, is being wound up voluntarily. Mr. L. H. Weatherley, F.C.A., is the liquidator.

MORE THAN ONE MILLION men and women are producing war material in American factories where Joint Labour-Management Production Drive Committees have been set up.

THE THARSIS SULPHUR & COPPER COMPANY, LIMITED, states that operations at the Glasgow works last year continued satisfactorily. Plant and machinery at the Hebburn works were disposed of at a satisfactory price.

NOTICE of an intended dividend is given by South Wales Metal Refiners, Limited. The last day for receiving proofs is June 17. The liquidator is Mr. J. B. Thompson, Bankruptcy Buildings, Carey Street, London, W.C.2.

A MEETING last week of truck, ladder and trolley manufacturers decided to form the Truck and Ladder Manufacturers' Association, of which the National Union of Manufacturers, 6, Holborn Viaduct, London, E.C.1, are the secretaries.

MR. T. WATSON, of General Refractories, Limited, has been appointed liaison officer for the Northern, North-Eastern and North-Western Areas for moulding and silica sands for foundries and steelworks. His address is Genefax House, Sheffield, 10.

AN AGREEMENT has been concluded between the Engineering and Allied Employers' National Federation and the Clerical and Administrative Workers' Union, which gives increased war allowances to members of the Union in engineering establishments.

THE JOINT CONTROLLERS of Non-Ferrous Metals have intimated that the use of spelter will no longer be generally permitted for hot galvanising of wrought-iron and steel tubes and tubulars, wrought-iron and malleable tube fittings, and fabricated and manipulated tubes.

THE MINISTER OF LABOUR has had under consideration recent stoppages of work at establishments in the East of Scotland, and has decided to appoint a Committee of Investigation, the members of which are the Hon. Lord Wark (chairman), Mr. William Elger, J.P., and Mr. J. B. Mavor.

FIRMS ENGAGED in organising and operating canteens, under the Factories (Canteens) Order, 1940, in Admiralty-supply, aircraft, munitions and other war equipment factories throughout the country have formed the National Society of Caterers to Industry, with head offices at 83, Pall Mall, London, S.W.1.

ARRANGEMENTS have been made to bring a considerable number of welding machines from America for use in the shipbuilding industry. Mr. R. B. Shepheard, a Senior Ship Surveyor on the staff of Lloyd's Register of Shipping, has been loaned to the Department of Merchant Shipbuilding and Repairs at the Admiralty for the purpose of advising shipbuilders on the use of welding.

PERSONAL

MR. ANDREW AGNEW, JUN., has been appointed assistant general manager of the South Wales branch of Baldwins, Limited.

MR. S. GUY NEWTON, a director of Brown Bayley's Steelworks, Limited, Sheffield, has been appointed managing director of the Barrow Hematite Steel Company, Limited.

MR. E. J. FOX, managing director of the Stanton Ironworks Company, Limited, for the past 25 years, is relinquishing his appointment and resigning from the board on June 30. Mr. Fox remains a director of Stewarts and Lloyds, Limited.

MR. F. J. MORRIS has been elected chairman of the Cable Manufacturers' Association in succession to Mr. Patrick Kelly, late managing director of the Edison Swan Electric Company, Limited. Mr. Morris was recently elected to the board of Edison Swan Cables, Limited.

MR. RICHARD MATHER has been elected chairman of the Skinningrove Iron Company, Limited, and the board have appointed Mr. H. G. W. Debenham as general manager and Mr. V. Pendred as general sales manager. The new chairman of the company was formerly technical director of the Tata Iron & Steel Company, Limited, of India, and was elected to the board of the Skinningrove Company in March last year.

SIR CHARLES CRAVEN, Controller-General at the Ministry of Aircraft Production, acting on medical advice, has tendered his resignation from the appointment, which he took up in June last year at the request of the Prime Minister and the Minister of Aircraft Production. Mr. Churchill and Col. Llewellin have accepted his resignation with great regret and have expressed high appreciation of his services. At Col. Llewellin's request, Sir Charles will, after a period of convalescence, act on a part-time basis as Chief Industrial Adviser to the Ministry.

Will

STEVEN, THOMAS, of Edinburgh, retired ironfounder... £32,752

JOHN FOWLER & COMPANY (LEEDS)

John Fowler & Company (Leeds), Limited, engine and machinery makers, of Hunslet, Leeds, was placed under an authorised controller appointed by the Ministry of Supply by an Order dated March 21, 1941, the company's share being transferred to nominees. The Treasury, in issuing a further Order in respect of the purchase of the shares, now announces that it is of opinion that the price (£2 5s. per share) to be paid "is not less than the value of those shares as between a willing buyer and a willing seller on March 21, 1941."

A goal of 15,000,000 tons of castings to be produced in 1942 was set the American foundry industry, declared Mr. H. S. Simpson at the annual meeting of the American Foundrymen's Association.

SUPER DUTY IRONS

OWING TO DEMAND FOR SUPER DUTY IRONS OUR PRESENT CAPACITY FOR FRESH WORK IS STRICTLY LIMITED; ENQUIRIES WILL CONTINUE TO HAVE OUR IMMEDIATE ATTENTION BUT WE CAN ONLY QUOTE DELIVERY DATES FOR CERTAIN CLASSES OF CASTINGS IN THE FOLLOWING RANGE OF MATERIALS:—

S·D·1 - 30—35	TONS TENSILE ON 1·2"	DIA BAR
S·D·2 - 35—40	ditto	ditto
S·D·3 - 40—45	ditto	ditto

ROBERT TAYLOR & CO. IRONFOUNDERS LTD

Telegrams: "TAYCO," Larbert
Telephones: 98 and 99 Larbert

LARBERT Stirlingshire

COMPANY NEWS

(Figures for previous year in brackets.)

Mitchell Shackleton—Interim dividend of 5% (same).

Robert Stephenson & Hawthorns—Dividend of 5% (same).

Barrow Hematite Steel—No dividend in respect of 1941 (5%).

Park Gate Iron & Steel Company—Dividend of 4% (same).

Crompton Parkinson—Interim ordinary dividend of 7½% (same).

J. Brockhouse & Company—Interim dividend of 7½% (same).

Mellowes & Company—Final dividend of 10%, making 20% (same).

Ambrose Shardlow & Company—Final dividend of 5%, making 7½% (same).

British Timken—Dividend of 15% (same) for the year to December 31 last.

Elmore's Metal—Net loss for 1941, £364 (£182); credit forward, £13,441 (£13,805).

Chubb & Son's Lock & Safe—Profit to March 31, £42,258 (£46,024); dividends, £18,633 (same).

John Thompson Engineering—Final ordinary dividend of 12½% and a bonus of 5%, making 22½% (same).

Parkinson & Cowan—Net profit for 1941, after tax, £45,395; first and final dividend on the ordinary shares of 5% (3%).

N. Greening & Sons—Profit for the year to April 30 last, before taxation, £29,680 (£23,232); final ordinary dividend of 5%, making 7½% (same).

Chloride Electrical Storage—Final dividend of 5%, together with a bonus of 5%, on the "A" and "B" ordinary shares, making 15% for the year (same).

Armstrong, Stevens & Son—Profit for the year to March 31, after E.P.T., £25,017 (£25,243); income-tax, £14,000 (same); dividend of 7½% (same); forward, £13,006 (£10,748).

Enfield Rolling Mills—Net profit for 1941, after tax, depreciation, debenture interest, etc., £12,062 (£23,579); brought in, £45,312; amounts over-reserved in 1939 and 1940, £52,448; dividend of 2½% (same); research and development written off, £8,000; forward, £94,822.

Newton Chambers & Company—Net profit for 1941, after depreciation and taxation, £73,606 (£71,132); registered notes repayment reserve, £30,000; final dividend of 10% on the ordinary shares, making 15% (same); forward, after preference dividend, £101,122 (£103,485).

Charles Clifford & Son—Net profit for 1941, after depreciation, war damage insurance and taxation, £18,164 (£22,505); reserve for war contingencies, £5,000; dividend on the preference shares, £900; final dividend of 2s. 6d. per share, free of tax, making 17½%, tax free (same); forward, £22,731 (£20,967).

OBITUARY

MR. JOHN GREENWOOD, late secretary of Marsden's Engines, Limited, Heckmondwike, died on May 26, aged 77.

MR. PEARSON MCADAM MUIR WHYTE, late stores superintendent of the Carron Company, Falkirk, died on June 1.

MR. HAROLD VINCENT JAMES died recently at Wolverhampton, at the age of 61. He was chairman of Joshua Bigwood & Son, Limited, Wolverhampton, H. Bisseker, Limited, Birmingham, and the Glyco Metal Company, Limited, Manchester, and a director of the Wolverhampton Metal Company. He was also associated with the James Bridge Copper Works, Limited, Walsall.

MR. GEORGE MURE RITCHIE, for many years a well-known figure in the iron and steel industry, died in Scotland on June 4. For a long period he was chairman of the Millom & Askam Hematite Iron Company, Limited, and the Barrow Steelworks, as well as Palmers Shipbuilding & Iron Company and several other concerns. At the time of his death he was a director of Siemens Bros. & Company, Limited, among other companies.

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

London Refractories Supplies, 529, Salisbury House, London, E.C.—£5,000.

Shelco (Engineering & Plastics), 52, Armitage Road, London, N.W.11—£7,000.

Knowsley Engineering Company (Manchester)—£1,000. J. and P. Casket, 18, Vine Street, Salford, Lancs.

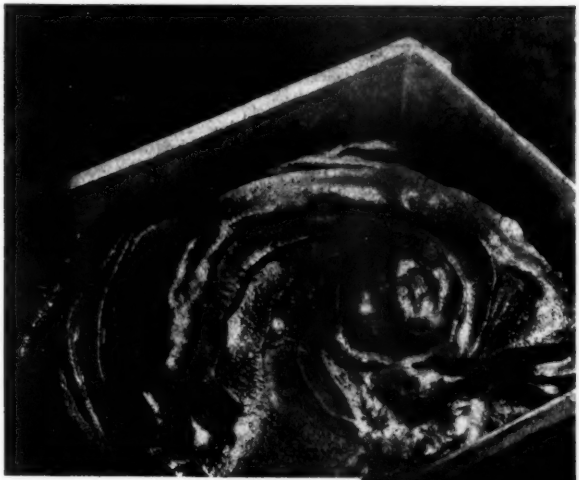
Canal Engineering Company (Bradford)—£2,000. E. J. A. Fattorini, Larkhill, Parsons Road, Heaton, Bradford; H. P., L. F. and J. Fattorini.

William G. Barnes—To take over the business of a metal merchant formerly carried on by the late Wm. G. Barnes, at Foundry Street and Gloucester Road, Brighton, and at Worthing. £5,000.

STONE PLATT ENGINEERING COMPANY

J. Stone & Company, Limited, and Platt Bros. & Company, Limited, are jointly concerned in the formation of a new private company called the Stone Platt Engineering Company, Limited, which has a capital of £200,000 in £1 shares. The objects are to carry on the business of engineers, metal manufacturers and merchants. Half the directors are to be appointed by J. Stone & Company and half by Platt Bros. & Company. The registered office is at 1A, Cockspur Street, London, S.W.1.

J. Stone & Company, engineers and founders, of Deptford, was formed in 1904, and has an issued share capital of £1,200,400. Platt Bros. & Company is controlled by Textile Machinery Makers, Limited.



Watch this Dictator of Firebrick Life

SOME USERS of refractory bricks are curiously careless as to the cement they employ. Whilst insisting upon sound and suitable bricks they build them with an inferior cement: they let cement dictate the life and durability of refractories. The shrewd user knows that a dependable cement is worth its cost many times over. Experience shows that in structures jointed with ordinary fireclay, extensive erosion originates in the joints. Joints made with G.R. cements are as hard and mechanically strong as the firebricks.

DURAX No. 3 is a 42/44% alumina, air-setting, high temperature jointing cement suitable for bonding firebrick linings working under high duty conditions. Its fine grading not only gives the cement good "workability", but also permits the brick-to-brick joint so desirable in furnace construction.

Details of other G.R. cements supplied on request.

General Refractories

LIMITED

GENEFAX HOUSE, SHEFFIELD 10 TELEPHONE: 31113 (6 lines)

G.P.19

Raw Material Markets

IRON AND STEEL

Business in iron and steel for the most part is confined to orders connected with the war effort, the volume of ordinary domestic trade and overseas business having been drastically reduced in order to accommodate the vast amount of urgent work for the various Government departments. Generally speaking, deliveries are coming through satisfactorily. Prices of iron and steel have been kept down to very reasonable levels since the outbreak of the war; advances have been few and the amounts involved have barely covered the increases which have occurred in the costs of production. It seems likely that fuel costs will appreciate further in the near future, and as these costs represent a considerable item in iron and steel makers' expenses, it would be unfair to expect them to shoulder these additional charges. The uncertainty regarding fuel prices need not hold up forward business in iron and steel, however, as all contracts are subject to a rise-and-fall clause.

The tempo of activity among makers of light castings does not quicken. Most of these firms are poorly placed for orders and it cannot be said that there is much likelihood of improvement in this section, as the war effort does not find much use for light castings. Ordinary domestic trade and overseas business have fallen off very considerably and the restrictions have left manufacturers with sparsely filled order-books. Short time is general in the light-castings trade, but a few makers have been able to readjust their plant to cope with the production of heavier castings, which are much in demand, and in these isolated instances works are busy. Heavy engineers continue to be fully engaged and can give little attention to other than priority orders. Pressure is being exerted by the Government for supplies of castings for machine tools, armaments, munitions, etc., and producers of these are given no respite.

Low-phosphorus iron is by no means plentiful, while hematite is in definitely short supply. As both of these grades are used extensively by general engineers, alternative qualities are sought, and it has been found that medium-phosphorus iron, refined and high-phosphorus grades, etc., fulfil most of the demands satisfactorily. In normal times the largest consumer of high-phosphorus iron is the light-castings industry, but requirements for this section are now at a low ebb. Ample supplies are forthcoming and many buyers have been permitted to purchase in excess of their early needs.

In the structural steel trade, there is a stronger demand for light materials, Government departments calling for quite substantial tonnages of light angles and reinforcing bars, but heavy joists and structural sections are not moving away in any great quantities and there is room for additional business. In fact, makers could accept orders for deliveries before the end of the current period, which ends on June 30. Shipbuilders, wagon and tank makers are taking up very large tonnages of plates, producers being fully booked up over some time ahead. Now that the production of galvanised sheets has been virtually stopped, only officially sanctioned orders being permitted, there is rather less activity in the sheet trade.

Steelworks and engineering concerns are getting quite satisfactory supplies of scrap iron and steel at the moment; but while the short-term position is healthy, the forward position gives rise to some amount of concern. Consumption is very heavy and consumers have little or no opportunity to stock, a process which they normally carry out in the summer as a precaution against delays in deliveries during the winter months. Heavy steel scrap is rather difficult to procure and works could do with much freer deliveries than they are now getting. Basic scrap, too, is in great demand for the steelworks and here, again, supplies are not over-plentiful. Users of iron railings are being kept well supplied and in many cases further deliveries have been temporarily suspended.

NON-FERROUS METALS

The tin-smelting works erected by the U.S. Government at Texas City has now begun large-scale operations following a period devoted to trial smeltings. The initial capacity of the works is about 25,000 tons, but further constructions are now in hand, and it is expected that the capacity will eventually be raised to some 50,000 tons of fine tin per annum. Stocks of tin ore have been accumulated gradually at Texas since the beginning of last year and now total more than 25,000 tons, so that the whole of the additional capacity of the new works now under construction will be fully employed for about one year before shipping considerations may bring to the fore the question of the diversion of Bolivian tin-ore shipments from British smelters to the U.S. plant at Texas.

Before the commencement of the Japanese campaign in the Far East the Belgian Congo ranked fifth in the sphere of tin production, but now that country occupies second place. According to "Tin," the publication of the Tin Producers' Association, in the 12 months ending June 30, 1941, the Congo's output of tin was 18,559 tons, and it is believed that during the current year the output will exceed this figure. The Commander-in-Chief of the Japanese forces in Malaya, Lt.-Gen. Yamashita, has recently stated that the large power station on the Pera river, which was severely damaged by the British Forces before they retreated has been restored and that tin-smelting works in Malaya have now resumed operations.

Large quantities of copper continue to be delivered to war factories in the United Kingdom, and all essential requirements are being promptly satisfied. There is no surplus, and supplies are allocated very carefully, but it is fairly certain that adequate tonnages will continue to be available for important consumers. This is in direct contrast to the position in Germany, where shortage of the red metal is acute. Our adversaries have adopted extreme measures to procure every scrap of copper from occupied territories, but even so they have to rely largely on substitute metals.

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